

Lightweight, High Strength Metals With Enhanced Radiation Shielding - Technology Advancing Partnerships Challenge Project

Center Innovation Fund: KSC CIF Program | Space Technology Mission Directorate (STMD)



ABSTRACT

The Technology Advancing Partnership (TAP) Challenge will seek to foster innovation throughout the Center by allowing the KSC workforce to identify a specific technology idea that needs improvement and to then work with an external partner to develop that technology. This Challenge will enable competitive partnerships with outside entities that will increase the value by bringing leveraged resources. The selected proposal from the University of Florida will develop new lightweight technologies with radiation mitigation for spacecraft.

ANTICIPATED BENEFITS

To NASA funded missions:

A major milestone for human exploration at Low Earth Orbit (LEO) and beyond Low Earth Orbit (b-LEO) is the mitigation of harmful secondary radiation to which astronauts are exposed. This technology would come up with a lightweight structural material that has the ability to mitigate neutron emission from secondary radiation, which would increase safety of the crew on the International Space Station (ISS).

To NASA unfunded & planned missions:

The safety of the crew for deep space human exploration (i.e. Mars) is imperative, particularly for missions that can potentially last years. This technology would mitigate some of the more harmful secondary radiation from galactic cosmic rays (GRCs) when compared to conventional metallic structural components.

To other government agencies:

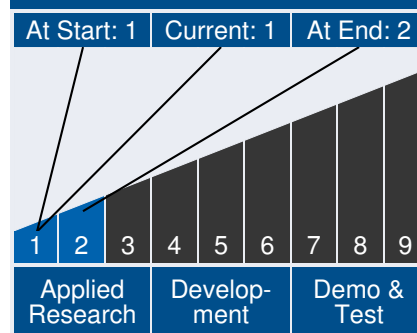
Other federal agencies including the Department of Energy (DoE) and Defense Advanced Research Projects Agency



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Technology Maturity



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(DARPA) would benefit from this technology for radiation shielding.

To the commercial space industry:

Private companies who want to travel to Low Earth Orbit (LEO) or beyond Low Earth Orbit (b-LEO) have the same requirements to keep their crew protected from secondary radiation emitted by interaction of galactic cosmic rays on vehicle and habitat materials. The material being developed would increase crew safety to NASA as well as the commercial space industry.

To the nation:

Benefits to the nation include increased safety of human exploration missions, both private and government. There is also the potential to use this technology for other Earth-based applications where neutron absorption is instrumental.

DETAILED DESCRIPTION

The alloy of interest will be magnesium-based, which will make it 70% lighter than steel and 65% of the density of aluminum, giving it a potential to decrease fuel consumption dramatically. Magnesium (Mg) has been approved by Federal and Joint Aviation standards and NASA standards state that it can be used in areas that are not prone to corrosion. Thus, the proposed applications include the skin or cladding within structural members or on non-oxidizing environments such as Mars. The Europe Commission is investigating the general use of Mg alloys for aerospace applications under the AEROMAG project, which considers the use of Mg as a breakthrough technology.

The objectives of the research are to 1) develop high strength Mg-based alloys doped with thermal radiation mitigation

Management Team

Program Director:

- John Falker

Program Executive:

- Karen Thompson

Program Manager:

- Nancy Zeitlin

Project Manager:

- Maria Wright

Principal Investigator:

- Maria Wright

Co-Investigators:

- Kelly Jordan
- Michele Manuel

Technology Areas

Primary Technology Area:

Human Health, Life Support & Habitation Systems (TA 6)

Secondary Technology Area:

Materials, Structures, Mechanical Systems & Manufacturing (TA 12)

Other Technology Areas:

- Habitation (TA 6.1.4)
- Radiation Mitigation (TA 6.5.2)
- Lightweight Concepts (TA 12.2.1)
- Innovative, Multifunctional Concepts (TA 12.2.5)

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(neutron-absorbing) elements, 2) characterize their microstructure and mechanical properties, and 3) characterize their radiation shielding efficiency. This work will be carried out at the University of Florida which houses state-of-the-art radiation testing facilities and light metals foundry capability of designing, fabricating, and testing any light weight structural material. The proposed work leverages existing programs supported by the University of Florida, National Science Foundation, and the Department of Energy.

The results of this work are not only expected to elucidate fundamental radiation shielding mechanisms inherent to doped Mg alloys but also explore the opportunity to integrate Mg into non-critical members, thus potentially creating a new area of research and center of excellence for NASA Kennedy Space Center.

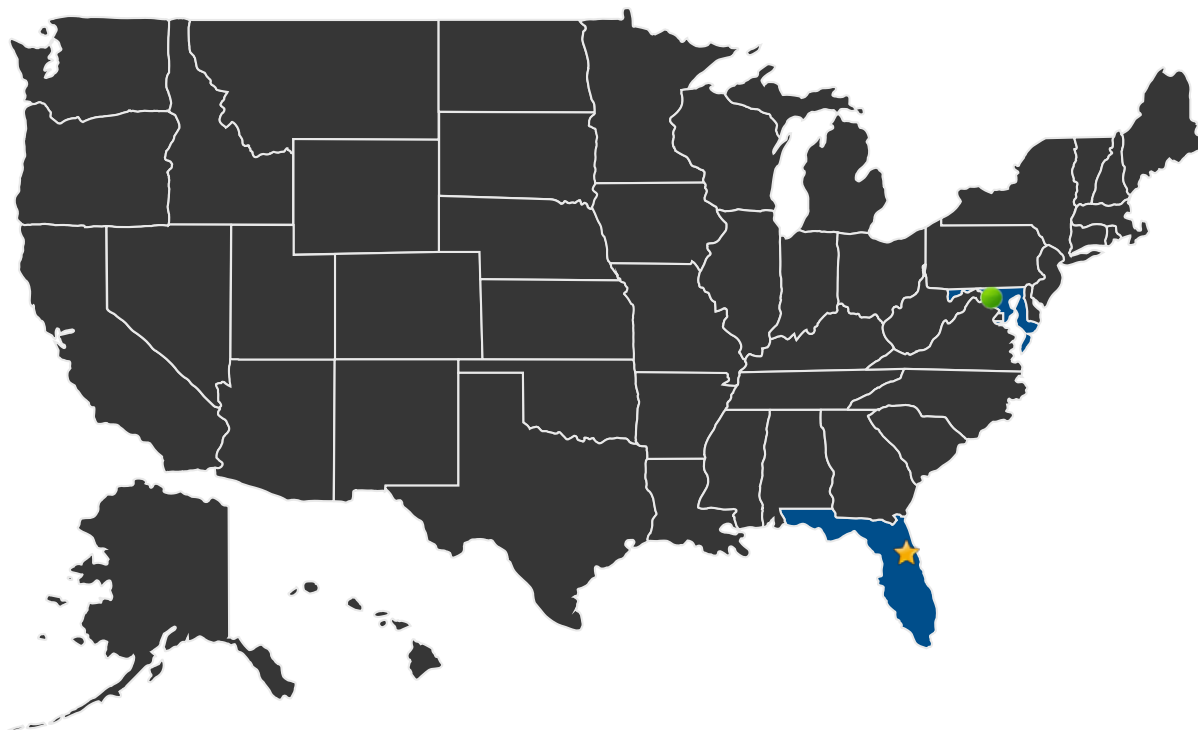
Active Project (2014 - 2015)

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U.S. LOCATIONS WORKING ON THIS PROJECT



■ U.S. States With Work

★ **Lead Center:**
Kennedy Space Center

● **Supporting Centers:**

- Goddard Space Flight Center

Other Organizations Performing Work:

- The University of Florida

TechPort

For more information visit techport.nasa.gov

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Some NASA technology projects are smaller (for example SBIR/STTR, NIAC and Center Innovation Fund), and will have less content than other, larger projects. Newly created projects may not yet have detailed project information.

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DETAILS FOR TECHNOLOGY 1

Technology Title

Lightweight, High Strength Metals With Enhanced Radiation Shielding

Technology Description

This technology is categorized as a material for other applications

The expected outcomes of the proposed work include an understanding and implementation of a lightweight Mg alloy that maintains or exceeds the mechanical properties and radiation shielding capability of existing materials used in spacecraft, such as stainless steel or Aluminum. Successful completion of the objectives will create a new opportunity on the use of Mg alloys for radiation shielding. This technology has the potential to create a new initiative on lightweight in space structures.

Capabilities Provided

Radiation mitigation of primary or secondary structural materials. Novel lightweight alloys for replacement of heavier steel and aluminum components.

Potential Applications

Potential applications for this technology in terms of space exploration includes manned spacecraft, planetary habitats, and planetary vehicles. Additionally, terrestrial applications include radiation mitigation for crews on commercial aircraft that have polar flights and protection for personnel working with nuclear reactors.

Performance Metrics

Metric	Unit	Quantity
Shielding Effectiveness		